Cortical Attention and Default Mode Networks in Focused Attention Meditators Assessed with fMRI

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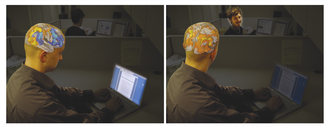
Introduction: Meditation & Attention

Meditation experience improves performance on attentionally demanding tasks (Valentine & Sweet 1999; Jha, Krompinger & Baime 2007; Lutz et al. 2009; MacLean et al. 2010; Elliott, Wallace & Giesbrecht 2014) and acutely alters patterns of neural activity measured with BOLD fMRI (Lazar et al. 2000; Brefczynski-Lewis et al. 2007; Brewer et al. 2011; Hasenkamp et al. 2012; Garrison et al. 2014).

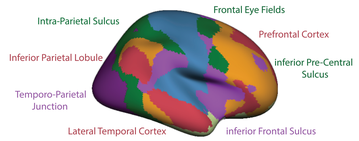


Corbetta, Patel & Shulman, 2008

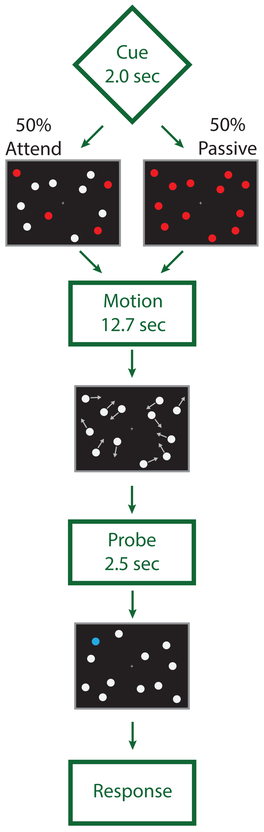
Hypothesis

Focused attention meditation induces trait-level changes in cortical networks supporting attentional function.

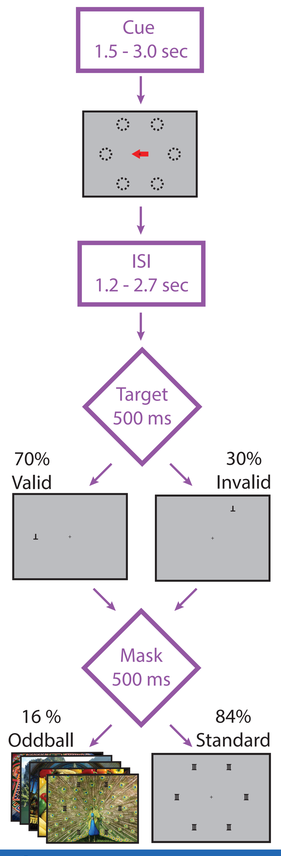
Two Attention Networks



Sustained Task



Capture Task



Methods

Scanning Parameters:
3 T Siemens Tim Trio
Gradient echo EPI sequences
TR = 2600 ms; TE =30 ms; flip angle = 90°
3.0 mm isotropic voxels; 42 quasi-axial slices
Anatomy: 1.0mm isotropic T1 MP-RAGE

Stimulus Properties:
16 trials (18.2 sec/trial) per run
Attend/Passive alternate trials
4 Runs, 64 trials/subject

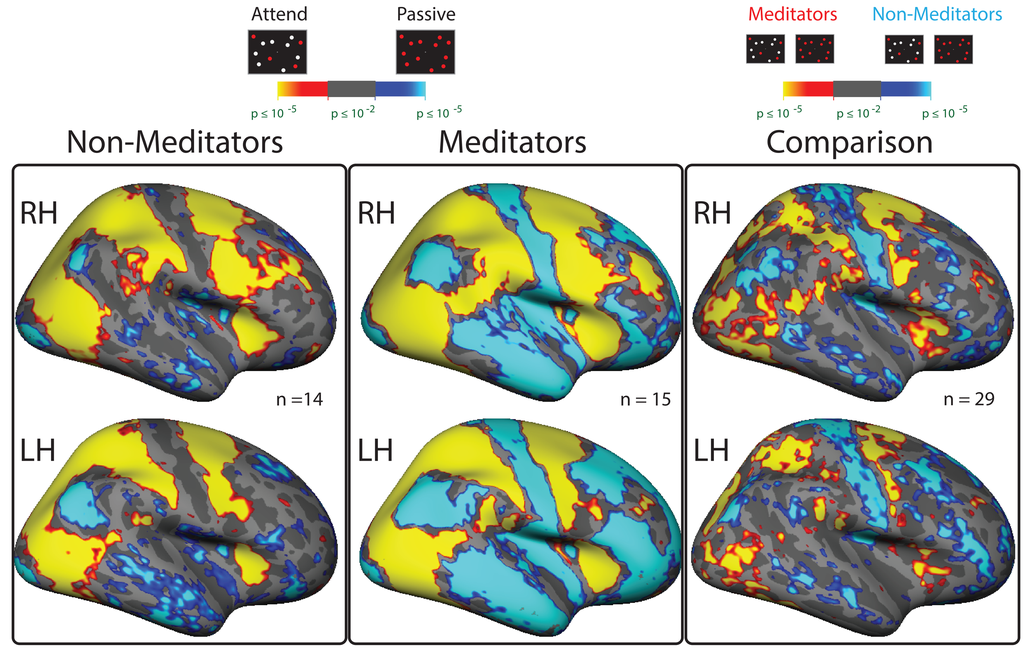
48 trials (7.8 sec/trial) per run
Cue validity = 70%
8 Oddball trials per run (1/6 trials)
4 Runs, 192 trials/subject

Recruitment:
Vipassana meditators snowball sampled
Control subjects matched on:
age, gender, education, hand & languages
Control subjects recruited with "sham" expertise

Demographics:
16 Vipassana meditators (5 female)
Mean hours/week = 14 ± 4

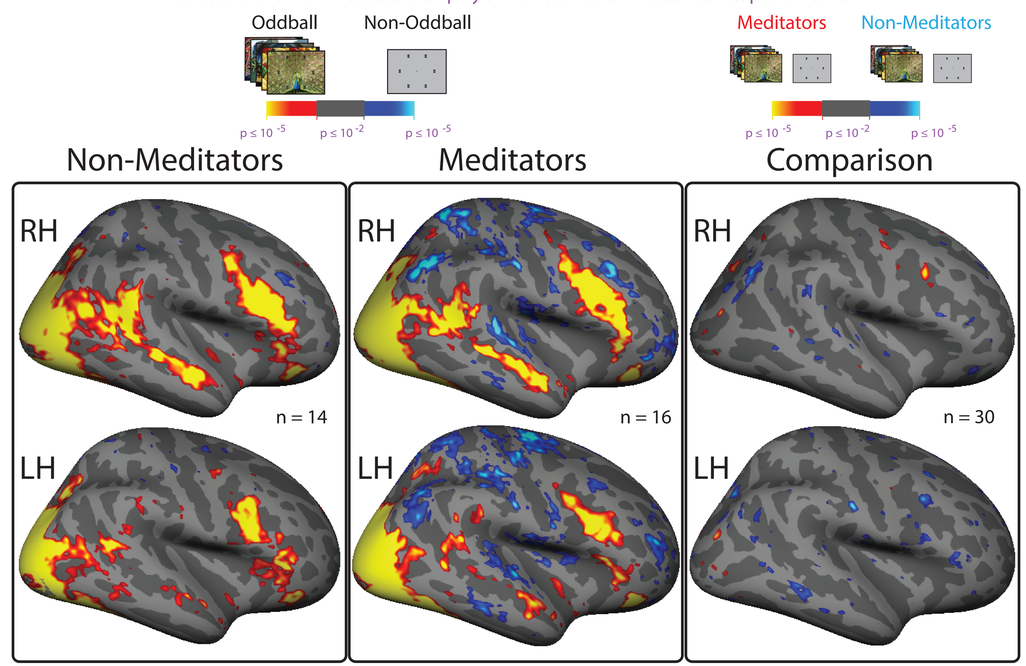
Increased Sustained Attention Activity in Meditators

Meditators activate dorsal attention network and supress default mode network more when sustaining attention.



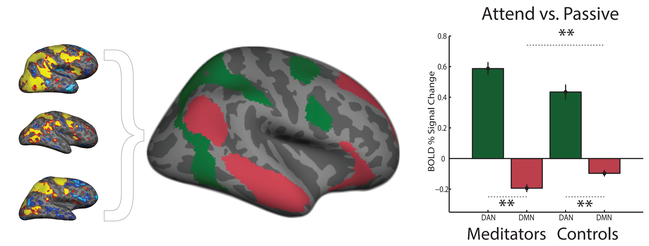
Unaltered Attentional Capture Activity in Meditators

Meditators and non-meditators display similar activation in attention capture network

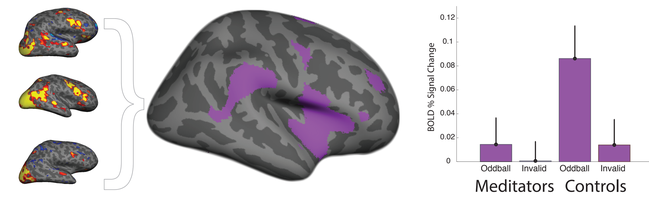


Region of Interest Analyses

Meditators display greater supression of Default Mode Network while attending.



Individual Subjects Network Regions of Interest



Meditators and Controls do not differ in response to attentional capture.

Conclusions

Here, we investigated activation in cortical attention networks while Vipassana meditators and matched controls conducted two demanding attention tasks. In a sustained attention task, **meditators demonstrated a greater separation between activity in the Dorsal Attention and Default Mode Networks while sustaining attention**, relative to controls. Conversely, **no differences were observed between meditators and controls during an attention capture task**.

- No Cost in Attentional Capture Associated With Meditation
- Greater DAN Activation and DMN Suppression in Meditators while Attending

Up Next:
H: Meditation experience is associated with increased ability to sustain attention in time, not increased attentional capacity.

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